

<b>1.</b>	<b>Purpose of and Need for the Proposed Action .....</b>	<b>1-1</b>
1.1	Description of the Proposed Action.....	1-1
1.1.1	Location and Termini .....	1-1
1.1.2	Proposed Action.....	1-1
1.1.3	Project History .....	1-3
1.1.4	Relationship to Other Proposed Actions .....	1-3
1.2	Purpose of Proposed Action .....	1-4
1.3	Need for Proposed Action.....	1-5
1.3.1	Land Use and Transportation Planning .....	1-5
1.3.2	System Linkage and Route Importance.....	1-10
1.3.3	Crash History.....	1-11
1.3.4	Existing Freeway Conditions and Deficiencies.....	1-13
1.3.5	Traffic Volumes .....	1-32
1.3.6	Summary of the Need for the Project.....	1-41
1.4	Local Government and Public Input .....	1-42
1.5	Environmental and Socioeconomic Aspects.....	1-42

## Tables

1-1	Milwaukee County Growth Projections .....	1-6
1-2	High Crash Rate Locations.....	1-11
1-3	Horizontal Alignment – Minimum Recommended Design Speeds and Actual Existing Design Speeds .....	1-23
1-4	Stopping Sight Distance – Minimum Recommended Design Speeds and Actual Existing Design Speeds .....	1-27
1-5	Bridges with Inadequate Vertical Clearance.....	1-29
1-6	Locations Where Minimum Ramp Spacing is Not Provided .....	1-31
1-7	Locations with Substandard Ramp Taper Rates.....	1-31
1-8	Ramps with Inadequate Acceleration or Deceleration Lanes.....	1-32

## Exhibits

1-1	Project Limits.....	1-2
1-2	Estimated Existing Southeastern Wisconsin Freeway System Traffic Congestion on an Average Weekday .....	1-7
1-3	Crash Rates: 2001–2005.....	1-12
1-4	Basic Pavement Components.....	1-14
1-5	Number of Pavement Overlays.....	1-15
1-6	Pavement Life .....	1-16
1-7	Bridge Terminology .....	1-17
1-8	Bridge Deterioration.....	1-19
1-9	Bridge Rehabilitation .....	1-21
1-10	Bridge Deficiencies .....	1-22
1-11	Existing Design Speed of Curves .....	1-24
1-12	Existing Design Speed Based on Stopping Sight Distance .....	1-26
1-13	Levels of Service Examples .....	1-33

# Section 1

## Purpose of and Need for the Proposed Action

1-14	Existing and Future Traffic Volumes (VPD) .....	1-34
1-15	Existing Traffic Operations – Morning Peak Hour (7 to 8 A.M.) .....	1-35
1-16	Existing Traffic Operations – Evening Peak Hour (4:30 to 5:30 P.M.).....	1-36
1-17	Major Traffic Generators .....	1-38
1-18	2035 No-Build Traffic Operations – Morning Peak Hour (7 to 8 A.M.) .....	1-39
1-19	2035 No-Build Traffic Operations – Evening Peak Hour (4:30 to 5:30 P.M.).....	1-40

# Purpose of and Need for the Proposed Action

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## 1.1 Description of the Proposed Action

### 1.1.1 Location and Termini

The Zoo Interchange is located in western Milwaukee County in southeastern Wisconsin at the junction of Interstate 94 (I-94), Interstate 894 (I-894), and United States Highway 45 (US 45), in the cities of Milwaukee, Wauwatosa, and West Allis (**Exhibit 1-1**). The study area encompasses the Zoo Interchange and its four approaches (referred to as the east, west, north, and south legs). The west terminus of the project is 124th Street, and the east terminus is 70th Street, a distance of about 3.5 miles. The south terminus of the project is Lincoln Avenue, and the north terminus is Burleigh Street, a distance of about 5.5 miles. The west, south, and east termini were selected to provide sufficient distance for matching back into the existing freeway alignment.

The Wisconsin Department of Transportation (WisDOT) and the Federal Highway Administration (FHWA) are studying the 108th Street (WIS 100, better known as Highway 100 locally) interchange on the west leg, the Greenfield Avenue (WIS 59) interchange on the south leg, and the 84th Street (WIS 181) interchange on the east leg. WisDOT and FHWA are studying these interchanges because of their proximity to the Zoo Interchange and their affect on the flow of traffic to and from the Zoo Interchange.

The north leg is longer than the east, west, and south legs. Unlike the east, west and south legs, freeway entrances and exits at Bluemound Road (US 18), Wisconsin Avenue, Watertown Plank Road, Swan Boulevard, Mayfair Road (Highway 100), and North Avenue are closely spaced. There is not a full interchange with US 45 at North Avenue because there is no exit from northbound US 45 to eastbound North Avenue. Instead, this exit is provided from US 45 onto Highway 100 south of North Avenue. For this reason, WisDOT and FHWA included the North Avenue interchange as part of this study, and established Burleigh Street as the terminus on the north because it will allow improvements to the North Avenue interchange to transition smoothly back into the existing freeway.

### 1.1.2 Proposed Action

The proposed action is to reconstruct the Zoo Interchange and the I-94, I-894, and US 45 approaches. The scope of the proposed action includes reconstructing the freeway and bridges, modifying interchange access to improve safety and traffic flow, reconstructing local streets affected by the freeway reconstruction, and enhancing the appearance of the reconstructed freeway.

### 1.1.3 Project History

Construction of the Zoo Interchange ended in 1963. In 1966, the Southeastern Wisconsin Regional Planning Commission (SEWRPC) completed a regional transportation system plan for the year 1990. This original transportation plan recommended several new freeway links, many of which were never constructed. An example is a once-planned outer beltway that would have connected I-94 in southern Milwaukee County to I-94 in Waukesha County and to US 41/45 in Washington County. In Milwaukee County, the planned Park West Freeway and Stadium Freeways were never completed. As a result, the freeway system now carries more traffic than initially projected.

In 1991, WisDOT began analyzing long-term improvements to three I-94 system interchanges in Milwaukee County: the Zoo Interchange, the Stadium Interchange, and the Marquette Interchange. By 1995, the Zoo Interchange study was merged with the two other system interchange studies and a study evaluating light rail transit and bus options in the I-94 east-west corridor, referred to as the I-94 East-West Corridor Study.

A Draft Environmental Impact Statement (EIS)/Major Investment Study (MIS) for the I-94 East-West Corridor Study was published in October 1996. WisDOT advanced a Locally Preferred Alternative (LPA) that included all the transportation components of the Draft EIS/MIS, such as reconstruction of the Marquette Interchange with design and safety improvements, reconstruction of I-94 to modern design standards, high-occupancy vehicle (HOV) lanes on I-94, expanded bus transit, added through lanes, and light rail transit. The Milwaukee County Board accepted the LPA but did not endorse implementation and only endorsed further study, funded entirely with federal and state funds.

The Waukesha County Board supported studying the reconstruction and modernization of I-94, including adding HOV lanes and expanding bus service, but opposed constructing light rail. The Waukesha County Board also supported preliminary engineering, completing the Final EIS, and separating the study of transportation improvements so that each improvement could advance independently.

Since development of the LPA completed the MIS process, FHWA closed the MIS process for the I-94 east-west corridor in Milwaukee and Waukesha counties. FHWA issued a notice in the June 26, 2000, *Federal Register* that the I-94 East-West Corridor Draft EIS would not be followed by a corridor-wide Final EIS or Record of Decision, because the MIS was in place and the components of the LPA were unlikely to proceed on the same schedule. With WisDOT as sponsor, only one element of the LPA (Marquette Interchange reconstruction) has advanced from preliminary engineering to final design and construction.

The Wisconsin Center District, in cooperation with the City of Milwaukee and Milwaukee County, took the light rail element of the LPA into further preliminary engineering study and is currently conducting a supplemental Draft EIS. Like the Wisconsin Center District study, this study builds upon the previous studies. The proposed action focuses on the Zoo Interchange and its approaches.

### 1.1.4 Relationship to Other Proposed Actions

Two other transportation studies are underway in the study area. Based on rapid development in and around the Watertown Plank Road interchange with US 45, Milwaukee County, the City of Milwaukee, the City of Wauwatosa, and WisDOT are examining traffic

patterns in western Milwaukee County, known as the West Suburban Traffic Impact Analysis (TIA). The limits of the study are Highway 100 on the west, Bluemound Road on the south, 84th Street on the east, and Menomonee River on the north.

The study focuses on the need for potential roadway improvements to enhance traffic operations on the local street system due to future development at the Milwaukee County Research Park, the Milwaukee Regional Medical Center, and the Milwaukee County grounds (see Section 1.3.5 and **Exhibit 1-16** for more information). This study is compatible with the recommendations of the West Suburban TIA study.

WisDOT and FHWA are also studying the conversion of US 41 and US 45 to an interstate highway from the Mitchell Interchange north to Green Bay via I-894, US 45, and US 41. The Zoo Interchange study team coordinates regularly with staff involved in the interstate conversion study because US 45 through the Zoo Interchange study area would be converted to an interstate designation. Both studies are consistent in using the same set of traffic forecasts and interstate standards to develop alternatives.

## 1.2 Purpose of Proposed Action

The purpose of the proposed action is to address the deteriorated condition of the study-area freeway system, obsolete design of the roadway and bridges, current and future capacity, and high crash rate. The proposed action would accomplish the following:

- Maintain a key link in the local, state, and national transportation network. Section 1.3 describes the project in the context of the regional transportation planning process and the role of the study-area freeway system in the local, regional, and national transportation network.
- Address the obsolete design of the study-area freeway system to improve safety. This includes replacing left-hand entrances and exits and providing proper weaving distances between exit and entrance ramps. Section 1.3 describes the outdated design that results in vehicles weaving across two or three lanes in a short distance, including closely spaced left- and right-hand entrance and exit ramps.
- Replace deteriorating pavement and bridges. Section 1.3 describes the poor condition of the pavement on the study-area freeway system, which has not been replaced since the early 1960s. Section 1.3 also documents the deteriorated condition of the bridges in the Zoo Interchange, which has resulted in some of the bridges being rated as low as a 4 on a scale of 1 (worst rating) to 9 (best rating), with the remaining bridges in the study area rated as 5 or 6.
- Accommodate future traffic volumes at an acceptable level of service. Section 1.3 describes current congestion on the study-area freeway system during the morning and afternoon rush hours and how congestion will worsen in the future.

The proposed action would neither require nor foreclose other future transportation improvements identified in the regional transportation plan. The proposed action would provide a safer and more efficient transportation system in the Zoo Interchange, while minimizing impacts to the natural and built environment to the extent feasible and practicable.

## 1.3 Need for Proposed Action

The need for transportation improvements in the Zoo Interchange corridor is demonstrated through a combination of factors, including the following:

- Regional land use and transportation planning
- System linkage and route importance
- Existing and future traffic volumes
- Crash history
- Existing freeway conditions and deficiencies

The remainder of this section discusses these factors in more detail. The need for improvements sets the stage for developing and evaluating possible improvement alternatives.

### 1.3.1 Land Use and Transportation Planning

SEWRPC, created by state statute in 1960, is the official planning agency for southeastern Wisconsin, which includes Kenosha, Milwaukee, Ozaukee, Racine, Walworth, Washington, and Waukesha counties.

SEWRPC's principal responsibility is to prepare a comprehensive plan for the physical development of the region. The key product is a regional land use plan upon which all other plan elements, including transportation, are based. Regional planning is conducted under the guidance of various technical coordinating and advisory committees with representatives from state and federal agencies; local planning, transportation and public works departments; transit providers and service groups; private utilities; and environmental organizations. Implementing the plan recommendations and the degree of implementation is the responsibility of local, state, or federal governments based on additional, focused planning, programming, and engineering/environmental studies, such as those conducted by WisDOT.

The following is a summary of adopted regional plans relevant to the Zoo Interchange study area.

**2035 Regional Land Use Plan for Southeastern Wisconsin—SEWRPC Planning Report No. 48 (June 2006).** The first regional land use plan was adopted in 1966 with updates adopted in 1978, 1994, 1997, and 2006 (current plan). The land use plan is based on an extensive database and inventory of the region's physical characteristics that has been maintained and updated by SEWRPC for more than 40 years. Physical characteristics pertinent to transportation demand include existing and future land use, growth and development trends/locations, and housing and employment trends. The 2035 regional land use plan is also based on an *intermediate growth scenario* that recommends the following:

- Seek a centralized regional settlement pattern that moderates the current trend toward decentralized land development.
- Stabilize and revitalize urban centers, particularly the Milwaukee urbanized area.
- Encourage new development as infill in existing urban centers with defined growth emanating outward from the existing urban centers.

- Plan new urban development at densities that effectively support essential urban services including water, sewer, and public transit.
- Protect remaining primary environmental corridors from incompatible urban development, discourage urban development in secondary environmental corridors, and preserve prime agricultural lands.

**Table 1-1** presents growth projections for Milwaukee County based on an intermediate growth scenario. SEWRPC projects vehicle miles traveled to increase by 16 percent between 2001 and 2035, which is equivalent to a 0.4 percent annual increase.

**TABLE 1-1**  
Milwaukee County Growth Projections

Growth Indicators	Percent Increase (2000–2035)
Population <sup>a</sup>	7.0
Households <sup>a</sup>	12.2
Employment <sup>a</sup>	6.6
Urban Land Use <sup>a</sup>	5.2
Vehicles Miles Traveled <sup>b</sup>	16.0

<sup>a</sup> Source: *2035 Regional Land Use Plan for Southeastern Wisconsin* (Tables 28, 30, 31, and 35). Percent increase for population, households, and employment for years 2003 to 2035.

<sup>b</sup> Source: *2035 Regional Transportation System Plan for Southeastern Wisconsin* (Table 107). Data are for arterial and highway systems under “no-build” scenario evaluated in the 2035 regional transportation system plan and for years 2001 to 2035.

### **A Regional Transportation System Plan for Southeastern Wisconsin: 2035—**

**SEWRPC Planning Report No. 49 (June 2006).** Similar to the land use plan, the first regional transportation system plan was adopted in 1966 with updates adopted in 1978, 1994, 1997, and 2006 (current plan). Based on population, household, employment growth, and other data from the regional land use plan, the transportation system plan forecasts traffic growth and transportation demand in the region. It also analyzes the ability of existing transportation facilities to address forecast traffic demand and meet air quality conformity requirements. SEWRPC’s regional traffic model has been in place for more than 40 years and determines future traffic demand. SEWRPC updates the model regularly to reflect changing trends. A transportation project must be listed in the regional transportation plan before it can be constructed. However, inclusion in the plan does not mean the project will be constructed.

Traffic forecasts reflect predicted growth patterns, number and types of trips made, routes taken, travel times, and other factors such as transit use. In its recommendations for providing additional highway capacity, the regional transportation plan recommends and incorporates the following:

- An intermediate growth scenario for the region and community land use planning that promotes compact development/redevelopment in areas that can use existing or expanded municipal sewer and water, and where higher density development can be served by transit, bicycle, and pedestrian facilities.
- A 100 percent increase in public transit in terms of revenue-transit vehicle miles. The increase in public transit includes the development of rapid and express transit systems

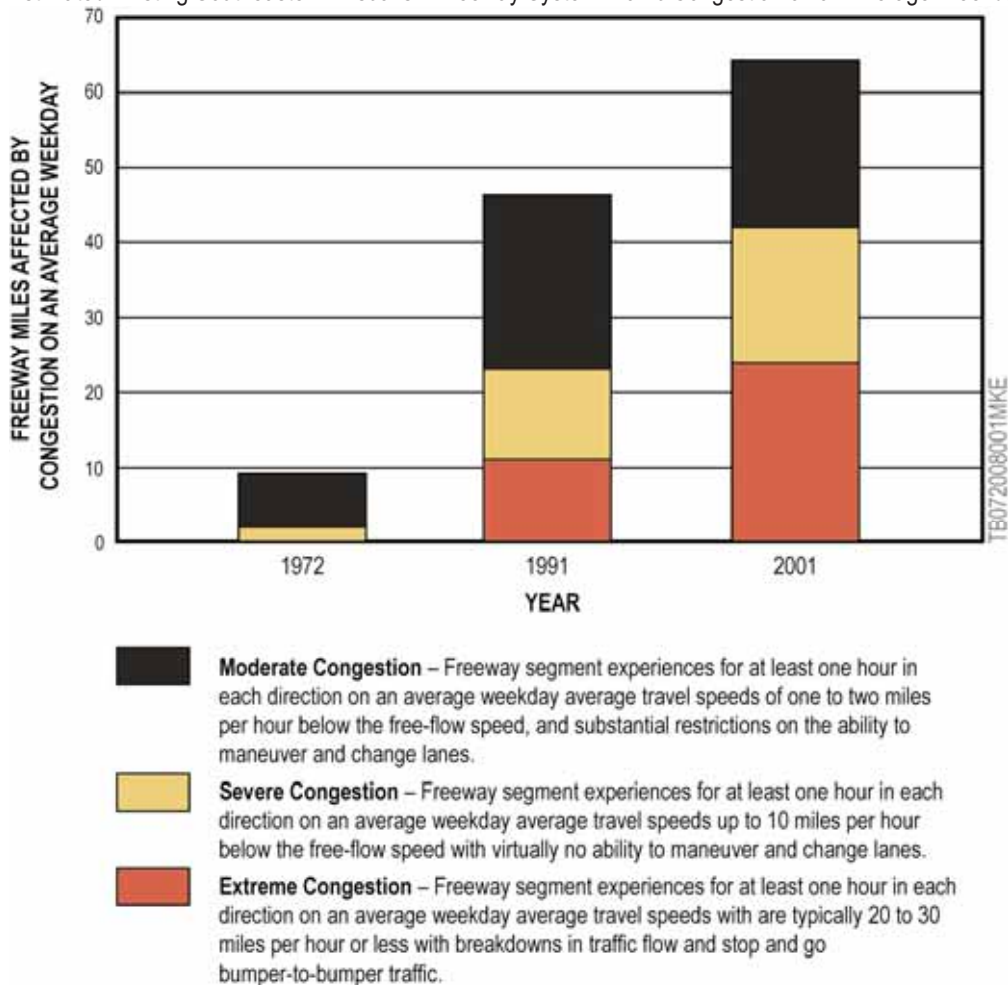
and substantial expansion of local bus systems where development density is sufficient to generate ridership.

- Reduced auto travel and improved efficiency of existing facilities before increasing highway capacity.
- Traffic flow and safety improvements on highways and arterial streets through measures such as intersection improvements and access management before committing to increasing highway capacity.

The regional transportation system plan identifies the traffic volumes and congestion that will remain even if the above actions are implemented. The plan estimated the increase in congestion that occurred on the southeastern Wisconsin freeway system between 1972 and 2001. Over the 29 years analyzed, the number of freeway miles affected by congestion increased sixfold (**Exhibit 1-2**).

#### EXHIBIT 1-2

Estimated Existing Southeastern Wisconsin Freeway System Traffic Congestion on an Average Weekday



Source: SEWRPC.

The plan evaluates street and highway capacity expansion (freeway and surface arterial) and makes recommendations to address the residual traffic volumes and congestion. The plan recommends about a 4 percent expansion of arterial lane miles over the next 30 years.

The 2035 regional transportation system plan includes the following recommendations for the Zoo Interchange study area:

- Expand I-94 from 6 to 8 travel lanes through the Zoo Interchange
- Expand the I-894 bypass from 6 to 8 travel lanes
- Expand US 45 from 6 to 8 travel lanes through the Zoo Interchange

The 2035 regional transportation system plan includes a note indicating WisDOT will perform preliminary engineering and environmental study on the proposed freeway widening (i.e., this study) to evaluate the need for additional capacity for the study-area freeway system.

**A Regional Freeway System Reconstruction Plan for Southeastern Wisconsin—SEWRPC Planning Report No. 47 (May 2003).** SEWRPC conducted the regional freeway system planning study at the request of WisDOT. The purpose of the study was to identify segments of the freeway system that would require reconstruction within the next 30 years and recommend whether certain freeway segments should be rebuilt as is, with minor redesign, with substantial redesign, or with additional traffic lanes. Implementing the plan's recommendations requires further consideration through preliminary engineering and the preparation of environmental documents for specific freeway improvement projects, based on WisDOT's prioritization of need and other factors.

SEWRPC conducted the 2003 regional freeway system planning study in the context of the 2020 regional land use and transportation system plans. The 2020 regional transportation system plan proposed modernization and limited expansion of the southeastern Wisconsin freeway system.

Based on the final meeting of the Southeastern Wisconsin Regional Freeway System Advisory Committee (April 2, 2003) regarding the 2003 freeway system plan, the committee made several freeway system recommendations for updates to the 2020 regional transportation system plan. The current 2035 regional transportation plan incorporates the committee's recommendations. Recommendations applicable to the Zoo Interchange study area include the following (adapted from the 2003 freeway system plan):

- Reconfigure the freeway-to-freeway system interchanges:
  - Eliminate left-hand on and off ramps.
  - Minimize lane drops and provide route continuity.
  - Improve freeway-to-freeway ramps to provide ramp speeds closer to freeway mainline speeds.
  - Address closely spaced service interchanges with grade separations or collector-distributor roadways.
- Improve freeway service interchanges:
  - Increase length and width of ramps.

- Convert multipoint exits to single-point exits.
- Provide selected auxiliary lanes to address closely spaced interchanges.
- Improve freeway mainline:
  - Improve horizontal and vertical curves, grades, and vertical clearance to meet modern design standards.
  - Provide full inside and outside shoulders.
  - Provide additional lane capacity (increase from 6 to 8 lanes) on I-94, I-894 south of the interchange, and US 45 north of the interchange.

The 2003 regional freeway system plan includes the following traffic operations information for the Zoo Interchange study area:

- The west, south, and north freeway legs of the Zoo Interchange serve substantial through vehicle travel. Through travel is defined as having trip ends outside the county in which the freeway segment is located.
- All interchange legs serve substantial inter-county traffic. Inter-county traffic has one trip end within the county and one trip end outside the county in which the freeway segment is located.
- All interchange legs have extreme congestion under existing traffic and year 2020 forecast traffic. Extreme congestion ranges between 6 and 14 hours on an average weekday.
- All interchange legs potentially need additional freeway traffic lanes.

The 2003 regional freeway system plan includes the following conceptual design recommendations for the Zoo Interchange study area:

- Reconstruct the Zoo Interchange and convert left-hand entrance and exit ramps to right-hand ramps, provide lane and route continuity, and smooth out horizontal curves and flatten vertical curves.
- Construct grade-separated ramp connections between the Zoo Interchange and adjacent Greenfield Avenue interchange on I-894 bypass.
- Construct collector-distributor roadways on US 45 in the segment from I-94 to Watertown Plank Road, and reconstruct interchange ramps at Wisconsin Avenue, Watertown Plank Road, and North Avenue.
- Construct grade-separated ramp connections between the Zoo Interchange and Highway 100 interchange on I-94.
- Reconfigure Highway 100 interchange on I-94, including a single-point exit for westbound traffic rather than the current two successive exits.
- Construct grade-separated ramp connections between the Zoo Interchange and adjacent 84th Street interchange on I-94.

The 2003 regional freeway system plan studied HOV and high-occupancy toll (HOT) lanes but did not recommend them for the regional freeway reconstruction plan for several reasons. The

I-94 East-West Corridor Study previously considered HOV lanes and received little to no support when proposed in the mid-1990s. Furthermore, implementing barrier-separated HOV and HOT lanes would require significant additional right-of-way and substantially increase freeway system reconstruction costs compared to adding regular freeway lanes (see Section 2.3.2 of this EIS and Appendix G of SEWRPC's 2035 regional transportation plan).

**SEWRPC 2009–2012 Transportation Improvement Program for Southeastern Wisconsin (March 2009).** SEWRPC is the federally designated metropolitan planning organization that ensures air quality conformance in the seven-county southeastern Wisconsin region. The six-county Milwaukee Transportation Management Area (Milwaukee, Racine, Kenosha, Ozaukee, Waukesha, and Washington counties) is a moderate non-attainment area under the 8-hour ozone National Ambient Air Quality Standards (NAAQS). Walworth County is a maintenance area under the 1-hour ozone NAAQS and an attainment area under the 8-hour ozone NAAQS. In accordance with the 1990 Clean Air Act Amendments, proposed highway improvements must be included in an approved Transportation Improvement Program (TIP) and the adopted regional transportation system plan to be in conformance with the State Implementation Plan (SIP) for air quality.

The SIP documents how the Wisconsin Department of Natural Resources (DNR) intends to meet its obligations to protect and enhance air quality. The SIP consists of many parts, each of which is approved by the United States Environmental Protection Agency (U.S. EPA) after allowing for public comment and a public hearing. Most parts of the SIP apply to all sources of air pollution in Wisconsin, while some "source-specific" parts of the SIP may apply to a single regulated entity.

On June 21, 2006, FHWA and Federal Transit Administration (FTA) determined that the 2035 regional transportation plan is in conformance with the state air quality implementation plan. FHWA and FTA also approved the regional emissions analysis prepared for the 2035 regional transportation system plan, which the 2009–2012 TIP serves to implement. See Appendix C of the 2009–2012 TIP for more information on conformity.

The Zoo Interchange study area is included in the 2009–2012 TIP as Project Number 66: "Reconstruction of the Zoo Interchange and approaches on I-94, I-894, and US 45 in Milwaukee County."

### **1.3.2 System Linkage and Route Importance**

I-94 is a major east-west freeway link across the northern United States connecting Detroit, Chicago, Milwaukee, Madison, St. Paul, Minneapolis and Billings, Montana. I-94 connects to I-90 in Billings and I-90 continues west to Seattle. I-894 is a bypass around Milwaukee for through traffic and provides an important freeway connection for several Milwaukee County communities. US 45 is a north-south highway link connecting the Upper Peninsula of Michigan, Oshkosh, Fond du Lac, West Bend, Milwaukee, Chicago's O'Hare International Airport, and points south.

The Zoo Interchange carries over 345,000 vehicles per day; more than any freeway interchange in Wisconsin. The Zoo Interchange is a gateway to Wisconsin's Fox River Valley (Oshkosh, Appleton, and Green Bay) and to Milwaukee area tourism venues (Milwaukee County Zoo, Wisconsin State Fair Park, and Mayfair Mall shopping center). In addition to serving long-distance travelers and regional and national freight movement, the study-area

freeway system is an important commuter route for many of the approximately 692,000 employees who work in Milwaukee and Waukesha counties.

The study-area freeway system is critical in moving health care patients to hospitals and trauma centers. The Milwaukee Regional Medical Center is located east of US 45 between Wisconsin Avenue and Watertown Plank Road. Its campus is home to several health care organizations: Blood Center of Southeastern Wisconsin, Children’s Hospital of Wisconsin, Curative Rehabilitation Services, Froedtert Hospital, and the Medical College of Wisconsin. The trauma center at Froedtert Hospital and the Medical College of Wisconsin is the only adult Level 1 trauma center in eastern Wisconsin, and Children’s Hospital of Wisconsin is one of only three Level 1 pediatric trauma centers in the state. (Level 1 means the center meets stringent national standards and provides the highest level of specialty expertise.)

I-94, I-894, and US 45 are part of the National Highway System. The National Highway System is a priority system of highways designated to ensure connectivity to the national defense highway network and other important regional transportation routes, and provides a high level of safety, design, and operational standards. I-94 is also a designated federal and state “long truck route,” allowing longer commercial vehicles to use the freeway. I-94, I-894, and US 45 are “backbone” routes in WisDOT’s draft *Connections 2030* long-range multimodal transportation plan (WisDOT, 2008a).

### 1.3.3 Crash History

WisDOT measures highway safety by the frequency and severity of crashes, and maintains a database of crashes on the state highway system. WisDOT uses the information to develop statewide average crash rates for highways. WisDOT and FHWA used Wisconsin statewide averages for urban freeways as the basis to evaluate the study-area freeway system. Crash rates are expressed as crashes per 100 million vehicle miles traveled and include all reported crashes that caused a fatality, injury, or property damage. From 2001 to 2005<sup>1</sup>, the average statewide urban freeway crash rate was 96. **Table 1-2** and **Exhibit 1-3** summarize the crash rates calculated for the study-area freeway system compared to the statewide average for similar roadways.

**TABLE 1-2**  
High Crash Rate Locations

Crash Rate	Applicable Area
2 to 3 times higher than the statewide average	Northbound I-894 near Greenfield Avenue
	Westbound I-94 near the Zoo Interchange
	Northbound I-894/US 45 through the Zoo Interchange
	Northbound I-894 to Westbound I-94
	Eastbound I-94 to Northbound US 45
	Westbound I-94 to Southbound I-894
3 to 4 times higher than the statewide average	Eastbound I-94 near Highway 100
	Southbound US 45/I-894 through the Zoo Interchange
Over 4 times higher than the statewide average	Eastbound I-94 near the Zoo Interchange

<sup>1</sup> 2005 was the most recent year evaluated for crash and traffic data. In 2006, the Marquette Interchange construction began, which noticeably impacted traffic volumes on the east leg of the Zoo Interchange study area.

On the study-area freeway system, there were 4,522 crashes (not including deer or other animal crashes) on the freeway and entrance/exit ramps at interchanges from 2001 to 2005, or roughly 2.5 crashes per day. Approximately 30 percent of those crashes resulted in injuries, and 9 crashes were fatal.

On the study-area freeway system and entrance/exit ramps, the most common types of crashes were:

- Rear-end crashes (57 percent)
- Single vehicle off-road crashes (22 percent)
- Sideswipe crashes (18 percent)

Rear-end and sideswipe crashes are often indicators of congestion as well as inadequate acceleration/deceleration lanes, weaving, and substandard ramp spacing. The presence of both left- and right-hand entrance and exit ramps is also a contributing factor to these crashes. In general, off-road crashes by single vehicles usually indicate tight curves with inadequate banking and narrow shoulders. This is reflected in the high crash rates on tight curves at the Highway 100 exit from westbound I-94; the northbound entrances to I-894 from Greenfield Avenue; and the Bluemound Road exit from northbound US 45 (see discussion of acceleration and deceleration lanes in Section 1.3.4).

At the entrance and exit ramp intersections with local streets, the most common types of crashes were rear-end crashes (47 percent), followed by angle crashes (36 percent), and single vehicle off-road crashes (12 percent). Many crashes are a result of excessive speed, especially during adverse weather conditions, or poor driver judgment. An inordinate amount of rear-end crashes are usually a result of inadequate deceleration distance along exit ramps. This distance may indicate that the ramp is too short, has inadequate width for storing traffic queues, has improper signal timing, or experiences a combination of these factors. Rear-end crashes may also indicate inadequate decision sight distances or inadequate stopping sight distances, due to disruption of sight lines from sharp vertical crest curves or obstructions along the inside of horizontal curves, such as traffic barriers along narrow shoulders. Angle crashes may indicate problems with intersection design as vehicles attempt to make left or right turns onto a local street. The off-road crashes indicate substandard ramp design and lack of a clear roadside recovery area. Section 1.3.4 documents existing freeway deficiencies.

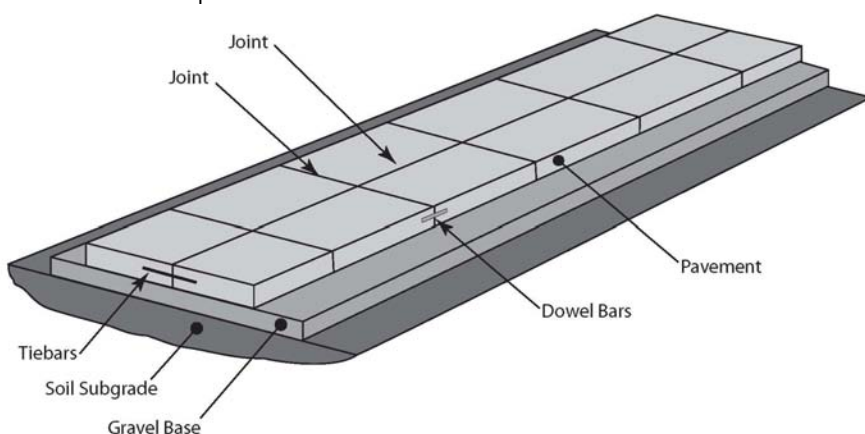
Crashes that occur on the study-area freeway system frequently cause traffic congestion, increasing travel times within the study area. The extent of the congestion depends on the severity of the accident and the number of lanes affected.

### **1.3.4 Existing Freeway Conditions and Deficiencies**

#### **Pavement Condition**

The study-area freeway system opened in 1963. Over the years, the original concrete pavement has worn and cracked. Water enters into pavement cracks and rusts the steel bars that hold the slabs of concrete together (**Exhibit 1-4**). Water also runs through the cracks to the gravel base under the pavement and can wash out the finer gravel material. This erosion leaves a void underneath the pavement and decreases the pavement's stability. Water expands when it freezes, widening existing cracks. Freeze-thaw cycles and heavy trucks add to pavement stress.

**EXHIBIT 1-4**  
Basic Pavement Components



WisDOT resurfaced I-94 and US 45 in the mid-1970s, and I-894 in the early 1980s. Resurfacing restored the roadway's smooth riding surface but did not address the cracks in concrete or the voids in the gravel base beneath. Since then, WisDOT resurfaced I-94 again in the late 1990s, and I-894 and US 45 a second and third time, most recently in the early 2000s (**Exhibit 1-5**). In general, each highway resurfacing has a shorter life span than the previous resurfacing because the original pavement, still in place after 45 years, provides a less effective base as the concrete continues to crack and deteriorate (**Exhibit 1-6**). Based on WisDOT's experience with other highways, resurfacing the study-area freeway system again would not be cost effective.

WisDOT pavement evaluation methodology permits a projection of pavement life expectancy. SEWRPC projected the remaining pavement life of southeastern Wisconsin freeways as a part of *A Regional Freeway System Reconstruction Plan for Southeastern Wisconsin* (SEWRPC, 2003b). The analysis estimated that the I-94 and I-894 pavement in the study area would reach the end of its life expectancy<sup>2</sup> between 2006 and 2010, and the US 45 pavement in the study area would reach the end of its useful life between 2011 and 2015.

## Bridge Condition

The structural condition of the study-area freeway system's bridges is an important factor in the need for the proposed action. The condition of the bridges has deteriorated over the years due to age, heavier than expected traffic, road salt, freeze-thaw cycles, and water entering cracks in the bridges. The bridge designs in the core of the Zoo Interchange exacerbate their deteriorated condition, as the following discussion of bridge types explains.

**Bridge Types.** Most highway bridges in Wisconsin are concrete or steel girder bridges. For example, the bridges over US 45 at Bluemound Road and Wisconsin Avenue are concrete girder bridges, and the bridges on I-94 over 84th Street and on Highway 100 over I-94 are steel girder bridges. These bridges have a deck, the concrete surface on which vehicles drive. The deck is supported by concrete or steel girders that lie horizontally under the deck. The girders are supported by vertical concrete piers, or columns, that are anchored in the ground. When the deck wears out, it can be removed and replaced. The girders, which typically last longer than the decks, remain in place (**Exhibit 1-7**).

<sup>2</sup> Life expectancy in the SEWRPC analysis was based on pavement condition, total traffic, truck traffic, construction history, and the number and timing of resurfacings.

Four bridges in the core of the Zoo Interchange are concrete box girder or concrete voided slab designs like those previously used in the Marquette Interchange. The concrete box girder bridges differ from typical girder bridges because they consist of long, hollow concrete “boxes” that rest on top of the piers. Instead of having a deck that rests on top of girders, the deck is a critical part of the box girder, contributing to its strength (**Exhibit 1-7**). Older concrete box girders, like those found in the Zoo Interchange, have two main disadvantages:

- Deck deterioration affects the bridge’s overall condition, rather than just the driving surface.
- The deck cannot be replaced separately from the rest of the box girder without the aid of extensive temporary supports underneath the bridge because the deck is part of the bridge’s load carrying structure.

Concrete voided slab bridges are similar to concrete box girder bridges because the deck is part of the bridge’s load carrying structure. However, they are thinner than concrete box girder bridges.

**Deterioration.** The six bridges in the core of the Zoo Interchange opened in 1963 and received a concrete overlay in the mid-1970s. Two received new decks in 1986. The other four bridges received a second concrete or asphalt overlay between 1995 and 2001. Typically, the overlays help make the driving surface smooth and in some cases slow down the rate of deterioration by sealing out water. The main deterioration on these bridges is hidden by overlays.

The bridges in the study-area freeway system were constructed using reinforced concrete. Reinforced concrete consists of concrete with steel reinforcing bars, known as rebar, placed in the concrete for added tensile strength. When the steel rebar is exposed to oxygen and road salt, it rusts. The deicing salts used on roads in Milwaukee County contain chlorides that accelerate the formation of rust. When the salt-laden water from the roadway enters the cracks in the concrete, it eventually comes in contact with the rebar causing the steel to rust and weaken. The rust on the rebar then expands and exerts pressure on the concrete, which cracks the concrete from within creating a spall, or pothole, on the top or bottom of the bridge (**Exhibit 1-7**).

As this process continues, the spalls become larger resulting in more pieces of concrete chipping and falling off the bridge and steel rebar losing overall strength (**Exhibit 1-8**). When spalls on the top of the bridge deck occur, an overlay of concrete or asphalt is needed. The overlay restores a smooth driving surface and offers some protection to the rusted steel rebar. As the overlay deteriorates, the steel rebar in the deck will continue to rust. The extent of this additional deterioration is not immediately visible and may become very severe before a pothole reappears on the deck surface. This extensive deterioration results in reduced load carrying capacity for the bridge, requiring repair or replacement. New concrete bridges have improved concrete, joints, and rebar.

In addition, the Zoo Interchange bridges carry more traffic than they were designed to carry. When the Zoo Interchange was designed, a more extensive freeway system was envisioned for southeastern Wisconsin. Eliminating several segments of the planned southeast Wisconsin freeway system resulted in the Zoo Interchange carrying three times more traffic than anticipated in a 1957 traffic analysis by the Milwaukee County Expressway Commission.

**Safety Factor.** The Zoo Interchange bridges are safe to drive on and are capable of carrying both legal load limits and over-weight permit loads; however, the bridges continue to deteriorate. The safety factor to which these bridges were originally designed and constructed has been reduced. The safety factor is based on truck loadings, not automobile loadings.

It is difficult to predict exactly when a particular bridge would reach the point of requiring weight restrictions. Nevertheless, it is prudent to address the issue before an emergency action is required. Based on data provided by WisDOT, SEWRPC determined the average remaining life expectancy of bridges within southeastern Wisconsin as a part of *A Regional Freeway System Reconstruction Plan for Southeastern Wisconsin* (2003b). According to the projections, the freeway bridges in the core of the Zoo Interchange are expected to require replacement between 2011 and 2015.

Only two actions can be taken to restore a bridge back to its original safety factor. One is to make structural improvements, and the other is to reduce the weight limits on the bridge. The first step in reducing weight limits is to prohibit all over-weight permitted loads. As the bridge continues to deteriorate, the reduction in weight limits would continue through the elimination of various sizes of trucks and ultimately closing the bridge to all traffic when it can no longer safely carry a 3-ton load, which is the weight of a car or pickup truck. However, interstate bridges are not allowed to reach this condition.

In fall of 2007, the US 45 southbound exit ramp to I-94 eastbound was closed for 2 weeks for bridge deck repairs (**Exhibit 1-9**), increasing delay and backups for vehicles on southbound US 45. This rehabilitation was required to keep the bridge in service and is expected to last until 2012. These types of closures and disruptions will become more frequent without reconstruction of the Zoo Interchange freeway bridges.

**Existing Bridge Condition Ratings.** The FHWA maintains the National Bridge Inventory (NBI), which is a comprehensive database of structural and appraisal data collected by each state for all bridges in the United States. This inventory includes each bridge's structural and functional properties. One of the appraisal ratings, the Structural Evaluation Appraisal Rating, was used to evaluate the condition of bridges on the study-area freeway system. This rating takes into account the condition of the bridge's girders and piers, in addition to the bridge's safe load level and the amount of traffic carried by the bridge (FHWA, 1995). The functional deficiencies of the study-area freeway system bridges are documented later in this section.

The appraisal ratings range from 0 to 9 with 9 being "superior to present desirable criteria" and 0 being a closed bridge. Several bridges in the study-area freeway system have a rating of 4. A Structural Evaluation Rating of 4 is defined as "meets minimum tolerable limits to be left in place as is." The study area bridges that have a rating of 4 are listed below and illustrated on **Exhibit 1-10**.

- The bridge carrying US 45 northbound over I-94 eastbound (B-40-0100 on **Exhibit 1-10**)
- The bridge carrying US 45 southbound to I-94 eastbound (B-40-0102 on **Exhibit 1-10**) – WisDOT rehabilitated the bridge deck in 2007.
- The bridge carrying I-894 northbound to I-94 westbound (B-40-0103 on **Exhibit 1-10**)
- The bridge carrying US 45 southbound over I-94 eastbound (B-40-104 on **Exhibit 1-10**)
- The Wisconsin Avenue bridge over US 45 (B-40-0131 on **Exhibit 1-10**)

As previously noted, the deterioration is the result of rusted rebar, which reduces the bridge's load carrying capacity and causes concrete to spall and chip. Higher than expected traffic volumes and outdated design has hastened the deterioration.

Of the remaining 42 bridges in the study-area freeway system, 12 are rated as 5 (fair), and 27 are rated a 6 (satisfactory). However, over the next few years, several of these bridges would likely decline to a 4 rating based on WisDOT's experience with bridge deterioration. For example, the bridges carrying Center Street and Bluemound Road over US 45 have a rating of 5, but their decks are in poor condition and will eventually need replacement.

### Freeway Design Deficiencies

Freeways must meet the minimum values for 13 controlling design criteria, such as alignments, lane and shoulder widths, and sight distance. Design standards developed for the controlling elements are based on the American Association of State Highway and Transportation Officials' (AASHTO's) 2001 *A Policy on Geometric Design of Highways and Streets* and AASHTO's *A Policy on Design Standards – Interstate System* (2005), as well as WisDOT's *Facilities Development Manual* and are the basis for evaluating the study-area freeway system for acceptability, function, and safety.

**Horizontal Curves.** On freeways, curves should be designed to allow the driver to negotiate the curves safely without reducing speed. A larger curve radius results in a more gradual curve and allows higher design speed. Another element that influences a vehicle's speed through a curve is the amount of banking, or super elevation, in the curve. Super elevation is the extent to which the roadway is banked to offset the tendency of vehicles to slide outward or overturn on a curve. A smaller curve radius requires more banking than a larger curve to ensure vehicle safety. Several curves in the study-area freeway system have a radius and super elevation that result in actual design speeds less than the recommended design speed (see **Table 1-3** and **Exhibit 1-11**).

**TABLE 1-3**

Horizontal Alignment—Minimum Recommended Design Speeds and Existing Design Speeds

Location	Minimum Recommended Design Speed (mph)	Existing Design Speed (mph)
I-94 west of the Zoo Interchange	60	45–60
I-94 east of the Zoo Interchange	60	45–60
US 45 north of the Zoo Interchange	60	45–60
I-894/US 45 south of the Zoo Interchange	60	60
Zoo Interchange Ramps:		
I-94 eastbound to US 45 northbound	45	30
I-94 eastbound to I-894 southbound	45	30
I-894 northbound to I-94 westbound	45	30
I-894 northbound to I-94 eastbound	45	30
I-94 westbound to I-894 southbound	45	30
I-94 westbound to US 45 northbound	45	30
US 45 southbound to I-94 eastbound	45	30
US 45 southbound to I-94 westbound	45	30

Design speed is the maximum safe speed that a driver can maintain over a specific section of highway. Factors such as highway type, topography, adjacent land use, and driver expectations affect design speed. To account for a wide range of vehicle running speeds, the design speed is generally 5 miles per hour (mph) greater than the posted speed limit. Based on WisDOT and AASHTO policy, **Table 1-3** summarizes the recommended design speeds for the study-area freeway system.

System interchange ramps connect one freeway to another. According to AASHTO, these ramps are typically designed for 70 to 85 percent of the freeway design speed. As a result, the minimum recommended design speed for each system interchange ramp in the Zoo Interchange is 45 mph (**Table 1-3**).

**Vertical Alignment.** Vertical alignment refers to the grade or steepness of a roadway. In general, the flatter the road, the safer it is to drive on. However, WisDOT and AASHTO guidelines recommend a slight grade on freeways to ensure that water properly drains off the roadway. On a completely flat road, water tends to pond, increasing the risk of vehicles hydroplaning. At the following ramp locations, the vertical grade is below the minimum 0.3 percent grade guidelines recommended for drainage:

- Northbound I-894 to eastbound I-94 has an existing grade of 0.05 percent.
- Southbound US 45 to eastbound I-94 has an existing grade of 0.07 percent.

**Cross Slope.** In addition to the vertical alignment, the roadway should have a crown that allows water to drain to the side of the road. Freeways are typically designed with a minimum 2 percent crown, or cross slope, to let water drain (the elevation of the road slopes down 2 feet for every 100 feet of road, or 0.25 inch for every 1 foot). Mainline pavement in the study-area freeway system was originally constructed with a 1.56 percent cross slope. When the freeway was resurfaced, the asphalt overlay was thicker near the center of the roadway to achieve a 2 percent grade on the outside driving lanes; however, the center lanes still have a cross slope below the minimum standard 2 percent.

**Stopping Sight Distance.** Stopping sight distance is the minimum distance required by a driver traveling at a given speed to stop a vehicle after sighting an object in its path.<sup>3</sup> Minimum stopping sight distance is based on the design speed of a roadway. On hill crests, sight is obstructed by the roadway between the driver and an object. At the bottom of a hill, sight is restricted at night because headlights do not fully illuminate the roadway ahead. On curves, a median barrier may reduce stopping sight distance. According to AASHTO standards, the minimum stopping sight distance should be 570 feet for the study-area freeway system, based on the recommended design speed of 60 mph. For the Zoo Interchange ramps (eastbound I-94 to northbound US 45 for example), the minimum required stopping sight distance should be 360 feet, based on the minimum recommended design speed of 45 mph. Most of the Zoo Interchange ramps do not meet the minimum stopping sight distance standards. **Table 1-4** and **Exhibit 1-12** note the locations on the study-area freeway system where the existing design speed is less than the minimum recommended design speed based on the minimum guidelines for stopping sight distance.

<sup>3</sup> Stopping sight distance differs from vertical alignment or grade. Stopping sight distance can be inadequate even if the vertical alignment is adequate and vice versa. A crest in the road or median barriers can interfere with the driver's line of sight around a curve and affect stopping sight distance. Vertical grade measures the steepness of a roadway. A gradual transition to a steep grade may not affect the driver's line of sight.

**TABLE 1-4**

Stopping Sight Distance—Minimum Recommended Design Speeds and Existing Design Speeds

Location	Minimum Recommended Design Speed (mph)	Existing Design Speed (mph)
I-94 west of the Zoo Interchange	60	40–60+
I-894/US 45 south of the Zoo Interchange	60	50–60+
I-94 east of the Zoo Interchange	60	40–60+
US 45 north of the Zoo Interchange	60	40–60+
Zoo Interchange Ramps:		
I-94 eastbound to US 45 northbound	45	30–49
I-94 eastbound to I-894 southbound	45	40–49
I-894 northbound to I-94 eastbound	45	30–49
I-94 westbound to US 45 northbound	45	30–49
US 45 southbound to I-94 eastbound	45	30–49
US 45 southbound to I-94 westbound	45	30–49

**Decision Sight Distance.** Decision sight distance provides a driver sufficient time for safe decision making. While stopping sight distance is the minimum distance required to bring a vehicle to a complete stop, decision sight distance gives a driver sufficient time to detect an object, recognize its threat potential, select an appropriate speed and path, and perform the required action safely and efficiently. These decisions most commonly occur prior to exits, major forks, and lane drops. The minimum decision sight distance is based on AASHTO and WisDOT's design criteria.

The following areas do not meet AASHTO or WisDOT's minimum standard for decision sight distance:

- The northbound I-894 ramp to westbound I-94
- The northbound I-894 ramp to eastbound I-94
- The eastbound entrance to I-94 at 84th Street
- The westbound entrance to I-94 at 84th Street
- The westbound I-94 ramp to northbound US 45
- The southbound US 45 ramp to eastbound I-94
- The northbound exit from US 45 at North Avenue
- The northbound entrance to US 45 at North Avenue
- The southbound exit from US 45 at North Avenue

**Cross Section.** A roadway's cross section refers to the ditches, shoulders, median, and travel lanes that make up the roadway. The width of travel lanes and width of shoulders on both the inside and outside of the travel lanes are key elements of freeway design. WisDOT and AASHTO policy, for roadways with three or more lanes, calls for 12-foot inside and outside shoulders. The outside shoulder width is less than 12 feet at all locations in the study area. Narrow inside shoulders result in distressed vehicles having to cross over three lanes of

traffic to reach a safe area on the outside shoulder. In addition, inside shoulders provide room for drivers to avoid crashes and give space for snow storage and emergency vehicle access. Locations with substandard inside shoulders are listed below:

- The inside I-94 eastbound shoulder from 116th Street to the Zoo Interchange is 4.5 feet.
- The inside I-94 westbound shoulder through the Zoo Interchange is 4.5 feet.
- The inside I-94 eastbound and westbound shoulders from 92nd Street to 84th Street are 2 feet.
- The inside I-894 northbound shoulder from Greenfield Avenue to Schlinger Avenue is 3.5 feet.
- The inside US 45 northbound and southbound shoulders through the Zoo Interchange are 2 feet.
- The inside US 45 northbound and southbound shoulders near the Bluemound Road interchange are 5 feet.
- The inside US 45 northbound shoulder near Swan Boulevard is 5 feet.

According to WisDOT guidelines, single-lane freeway ramps should have a 22-foot width measured from face of curb-to-face of curb. Locations of curbed ramps with a substandard width of less than 22 feet are listed below:

- The Highway 100 entrance to westbound I-94
- The I-94 westbound exit to northbound Highway 100
- The I-94 eastbound exit to Highway 100
- All ramps at the Greenfield Avenue interchange
- Portions of the I-94 eastbound exit to 84th Street
- Portions of the I-94 westbound exit to 84th Street
- All the Zoo Interchange ramps
- All the ramps at the Bluemound Road interchange
- All the ramps at the Wisconsin Avenue interchange
- Portions of the US 45 northbound exit to Watertown Plank Road
- Portions of the US 45 southbound exit to Watertown Plank Road
- Portions of the US 45 southbound entrance from Watertown Plank Road
- The US 45 northbound exit to North Avenue
- The US 45 southbound entrance from North Avenue
- The US 45 southbound exit to eastbound North Avenue
- The US 45 southbound exit to westbound North Avenue

**Vertical Clearance.** Vertical clearance is the distance between a roadway and a bridge over it. Adequate vertical clearance is required to prevent tall trucks from hitting overpasses. Minimum vertical clearance requirements differ based on the type of roadway. Since interstate highways are part of the National Highway System, they require a minimum 16-foot clearance to accommodate oversized vehicles. WisDOT and AASHTO guidelines call for a 16-foot, 4-inch clearance to allow for a 3- to 4-inch asphalt overlay in the future. More than half the bridges in the study area do not meet the minimum vertical clearance criteria. **Table 1-5** lists the substandard locations and the minimum criteria.

**TABLE 1-5**  
Bridges with Inadequate Vertical Clearance

Location	Minimum Vertical Clearance Criteria	Existing Vertical Clearance
Northbound Highway 100 over I-94	16' 4" (freeway)	16' 2"
92nd Street over I-94	16' 4" (freeway)	14' 8"
Eastbound I-94 over 84th Street	16' 3" (arterial)	15' 10"
Westbound I-94 over 84th Street	16' 3" (arterial)	15' 10"
Northbound I-894 to westbound I-94 over southbound US 45	16' 4" (freeway)	14' 1"
Southbound US 45 over eastbound I-94	16' 4" (freeway)	15' 2"
Northbound US 45 over eastbound I-94	16' 4" (freeway)	14' 4"
Southbound US 45 over westbound I-94	16' 4" (freeway)	14' 3"
Northbound US 45 over westbound I-94	16' 4" (freeway)	14' 5"
Southbound US 45 to eastbound I-94 over northbound US 45	16' 4" (freeway)	14' 11"
Eastbound Bluemound Road over US 45	16' 4" (freeway)	14' 2"
Westbound Bluemound Road over US 45	16' 4" (freeway)	15' 6"
Wisconsin Avenue over US 45	16' 4" (freeway)	14' 5"
Northbound US 45 over Watertown Plank Road	16' 3" (arterial)	14' 8"
Swan Boulevard over US 45	16' 4" (freeway)	15' 0"
Southbound US 45 over Highway 100	14' 9" (arterial w/ no interchange)	14' 4"
Northbound US 45 over Highway 100	14' 9" (arterial w/ no interchange)	14' 4"
Union Pacific Railroad over US 45	16' 4" (freeway)	15' 6"
Southbound US 45 over North Avenue	16' 3" (arterial)	15' 5"
Northbound US 45 over North Avenue	16' 3" (arterial)	14' 7"
Meinecke Avenue over US 45	16' 4" (freeway)	14' 10"
Center Street over US 45	16' 4" (freeway)	14' 7"

**Lane and Route Continuity.** Continuity implies that drivers following a particular route need not change lanes or exit in order to remain on the route. The principle of route continuity simplifies the driving task because it conforms to what drivers expect, reduces lane changing, and delineates the through route. Continuity is accomplished by adding and dropping lanes only on the right and through special system interchange designs. An interstate route through an interchange should, at a minimum, provide two through lanes. Additional lanes may be necessary depending on the traffic volumes carried by the route and the proximity of adjacent entrance and exit ramps.

Lane and route continuity were assessed throughout the study-area freeway system. The Zoo Interchange lacks lane continuity due to through lanes becoming exit only lanes on each approach as indicated below:

- The inside lane on eastbound I-94 becomes a left-hand exit to northbound US 45.
- The outside lane on northbound US 45 becomes the exit to eastbound I-94.
- The inside lane on westbound I-94 becomes a left-hand exit to southbound I-894.
- The inside lane on southbound US 45 becomes a left-hand exit to eastbound I-94.

**Interchange Configuration and Spacing.** System interchanges, like the Zoo Interchange, are interchanges that connect freeways. Service interchanges, like the Watertown Plank Road interchange, are interchanges that connect freeways with surface streets and cross roads. The Zoo Interchange and service interchanges located in the study-area freeway system have numerous ramps that do not meet current design criteria or standards.

**Left-Hand Entrances and Exits.** The Zoo Interchange was designed with left-hand entrances and exits. National design guidelines call for all freeway entrances and exits to be on the right side (AASHTO, 2001). Left-hand entrance and exit ramps violate driver expectancy. The left-hand ramps in the Zoo Interchange combined with closely spaced service interchanges at Highway 100, Greenfield Avenue, 84th Street, and Bluemound Road create unsafe situations where drivers must weave across multiple lanes in a short distance to reach their exit:

- The left-hand entrance from northbound I-894/US 45 to westbound I-94 is less than 0.3 mile from the right-hand exit to northbound Highway 100.
- The left-hand entrance from westbound I-94 to southbound I-894 is approximately 0.5 mile from the right-hand exit to Greenfield Avenue.
- The left-hand entrance from southbound US 45 to eastbound I-94 is approximately 0.3 mile from the right-hand exit to 84th Street.
- The left-hand entrance from eastbound I-94 to northbound US 45 is approximately 0.4 mile from the right-hand exit to Bluemound Road.

On the study-area freeway system, these configurations are the single largest reason for the high crash rate. According to WisDOT's Facilities Development Manual (FDM), FHWA research indicates that the use of right-hand entrances and exits compared to left-hand ramps may reduce crashes by 25 to 70 percent. Refer to Section 1.3.3, Safety, and **Exhibit 1-3** for additional information.

**Ramp Spacing.** The risk of crashes increases when successive entrance and exit ramps are close in proximity or when through traffic is disrupted by lane changes while entering or exiting the freeway. A combination of these factors creates dangerous weaving segments in the study-area freeway system. WisDOT and AASHTO guidelines call for 2,000-foot spacing between entrance and exit ramps on freeways to provide adequate weaving distance and space for signing (AASHTO, 2001). **Table 1-6** lists locations where the study-area freeway system does not provide the minimum ramp spacing.

**TABLE 1-6**  
Locations Where Minimum Ramp Spacing is Not Provided

Location	Minimum Spacing Required (feet)	Existing Spacing Between Ramps (feet)
US 45 northbound entrance ramp from Wisconsin Avenue to the US 45 northbound exit at Watertown Plank Road	2,000	875
US 45 southbound entrance ramp from Watertown Plank Road to the US 45 southbound exit at Wisconsin Avenue	2,000	1,225
I-894/US 45 northbound entrance ramp from Greenfield Avenue to the eastbound I-94 exit	2,000	1,555
I-94 westbound entrance ramp from I-894/US 45 northbound to the northbound exit at Highway 100	2,000	1,565
I-894/US 45 southbound entrance ramp from I-94 eastbound to the Greenfield Avenue exit	2,000	1,645
I-94 eastbound entrance ramp from US 45 southbound to the 84th Street exit	2,000	1,765

**Ramp Taper Rates.** Adequate merging distance can be measured by a ramp's taper rate. According to WisDOT and AASHTO standards, the taper rate for a freeway entrance ramp should be 50:1, which means the merge lane becomes one foot narrower every 50 feet. Similarly, the taper rate for a freeway exit ramp should be 12.5:1. **Table 1-7** lists locations with substandard ramp taper rates.

**TABLE 1-7**  
Locations with Substandard Ramp Taper Rates

Location	Minimum Taper Rate Criteria	Existing Taper Rate
I-94 eastbound exit to Highway 100	12.5:1	None
US 45 southbound entrance from North Avenue	50:1	7.1:1
I-94 eastbound entrance from Highway 100	50:1	25:1
US 45 northbound exit to Highway 100	12.5:1	7.1:1
I-894 southbound exit to Greenfield Avenue	12.5:1	7.6:1
US 45 northbound exit to Watertown Plank Road	12.5:1	7.6:1
US 45 southbound exit to westbound North Avenue	12.5:1	10:1

**Acceleration and Deceleration Lanes.** Ramp design includes careful consideration of adequate acceleration lanes on entrance ramps and deceleration lanes on exit ramps so that entering vehicles can accelerate to freeway speed before merging with freeway traffic. If there is a difference in speed between vehicles on the freeway and vehicles entering the freeway, then crashes can occur from the resulting congestion as vehicles decelerate on the freeway to allow the vehicles to enter. Exit ramps should be designed to provide enough distance to safely decelerate on the ramp rather than on the freeway.

The required lengths of the acceleration and deceleration lanes vary depending on the tightness of curves on the ramp. An entrance ramp that has a gradual curve allows drivers to accelerate on the ramp; therefore, the length of the acceleration lane can be shorter than an entrance ramp with tighter curves.

**Table 1-8** lists entrance and exit ramps that have inadequate acceleration and deceleration lengths based on AASHTO freeway design guidelines.

**TABLE 1-8**  
Ramps with Inadequate Acceleration or Deceleration Lanes

Location	Minimum Lane Length Needed (feet)	Actual Acceleration/Deceleration Lane Length (feet)
I-94 eastbound exit to Highway 100	235	0
I-94 westbound entrance from Highway 100	550	500
I-94 westbound exit to southbound Highway 100	410	225
I-94 westbound exit to northbound Highway 100	350	115
I-894 northbound exit to Greenfield Avenue	380	225
I-894 northbound entrance from eastbound Greenfield Avenue	810	405
I-894 northbound entrance from westbound Greenfield Avenue	670	330
US 45 northbound exit to Bluemound Road	410	230
US 45 southbound entrance from North Avenue	670	530

### 1.3.5 Traffic Volumes

This section describes the existing and projected future traffic volumes on the study-area freeway system. Roadways are typically designed to accommodate traffic volumes projected to occur 20 to 25 years into the future. For this study, 2035 is the “design year.”

Traffic volume is not the only factor that indicates roadway congestion, especially during heavy travel periods. Level of service is the measure of a roadway’s congestion, which uses rankings ranging from A to F. Freeway level of service is based on the number of vehicles per hour per lane, with level of service A exhibiting free-flow traffic and level of service F exhibiting severe congestion that approaches gridlock (**Exhibit 1-13**). FHWA guidance calls for freeways to provide level of service C; however, level of service D is acceptable in urban areas like Milwaukee County.

#### Existing Traffic Volumes

The Zoo Interchange carries over 345,000 vehicles on an average weekday. Current (2005<sup>4</sup>) average weekday traffic volumes on US 45 north of the Zoo Interchange range from 153,000 vehicles per day (vpd) near North Avenue to 171,000 vpd just north of the Zoo Interchange. Existing traffic volumes on US 45/I-894 are 153,000 vpd near National Avenue, south of the Zoo Interchange (**Exhibit 1-14**). Current (2004) traffic volumes on I-94 range from 174,000 vpd east of the Zoo Interchange to 152,000 vpd west of Highway 100 (WisDOT, 2005a).

Between 1995 and 2004, traffic volumes on the study-area freeway system increased approximately 12 percent, about 1.3 percent per year.

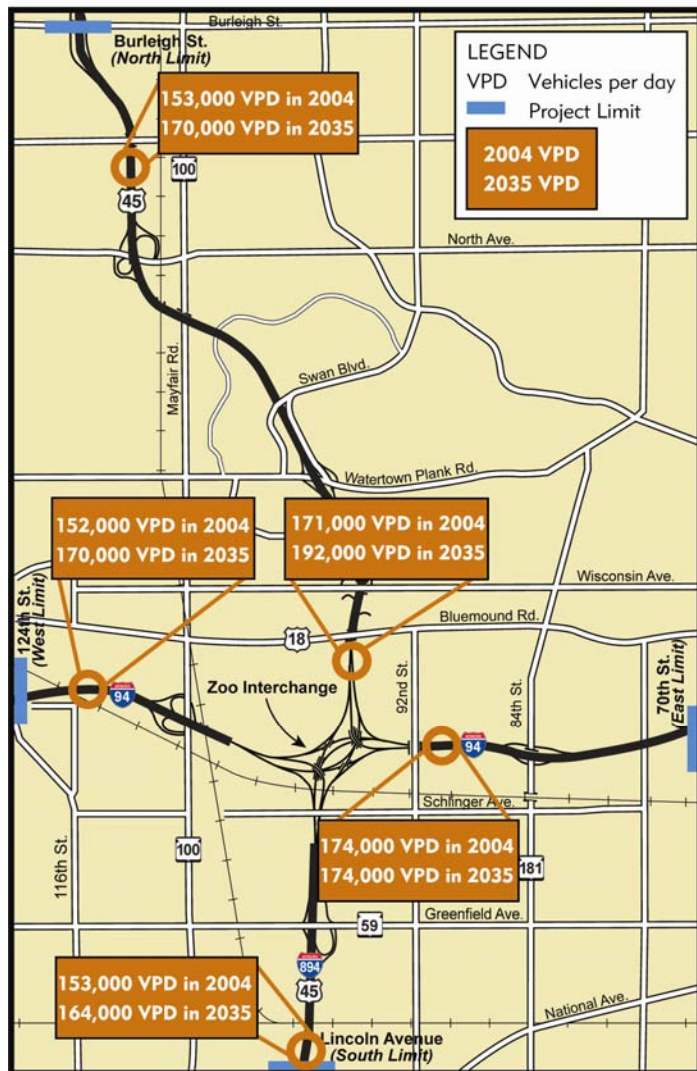
<sup>4</sup>2005 was the most recent year evaluated for crash and traffic data. In 2006, the Marquette Interchange construction began, which noticeably impacted traffic volumes on the east leg of the Zoo Interchange study area.

During the heaviest traffic periods, the level of service on US 45 north of the Zoo Interchange normally ranges between level of service D and level of service E. Level of service is generally D south of the Zoo Interchange on US 45/I-894. Similarly, level of service on I-94 west of the Zoo Interchange usually ranges between level of service D and level of service E, while it is generally level of service E east of the Zoo Interchange (**Exhibit 1-15** and **Exhibit 1-16**). There are segments operating at level of service F (severe congestion) on all four approaches to the Zoo Interchange during the heaviest traffic periods:

- Northbound US 45 between Wisconsin Avenue and Watertown Plank Road during the morning peak hour
- Southbound US 45 between Wisconsin Avenue and Bluemound Road during the morning peak hour
- Southbound US 45/I-894 between Greenfield Avenue and Lincoln Avenue (south study limit) during the evening peak hour
- Northbound US 45/I-894 between Greenfield Avenue and the Zoo Interchange during the morning peak hour
- Westbound I-94 between the Zoo Interchange and Highway 100 during the evening peak hour
- Eastbound I-94 between the Zoo Interchange and 84th Street during both the morning and evening peak hour
- Westbound I-94 between 84th Street and the Zoo Interchange during the evening peak hour
- The ramp carrying southbound US 45 to eastbound I-94 during both the morning and evening peak hour
- The ramp carrying northbound US 45/I-894 to westbound I-94 during both the morning and evening peak hour

EXHIBIT 1-14

Existing and Future Traffic Volumes (VPD)



## Future Traffic Volumes

The 2035 travel forecasts take into account the recent and planned development in the study area (**Exhibit 1-17**), which includes the following:

- Proposed construction of a new University of Wisconsin-Milwaukee engineering campus on the Milwaukee County grounds
- Redevelopment of the Milwaukee County Behavioral Health Complex (at the Regional Medical Center) at the US 45/Watertown Plank Road interchange
- Continued development of the Milwaukee County Research Park on the west side of US 45
- Redevelopment of 74 acres of land adjacent to the US 45/Burleigh Road interchange just north of the study area (not shown on **Exhibit 1-17**)

Each development would further increase traffic on the study-area freeway system. Furthermore, the Milwaukee Regional Medical Center has plans to develop an additional 4 million square feet on their campus between 2007 and 2018. Wisconsin State Fair Park is also seeking to become a year-round destination with plans for a hotel on the north end of the grounds and by developing 6 acres along Greenfield Avenue for a restaurant, hotel, and retail space related to the Milwaukee Mile racetrack.

Traffic volumes on the study-area freeway system are expected to continue increasing, although at a slower rate than previously. By the design year 2035, traffic volumes on US 45 north of the Zoo Interchange are expected to increase 11 percent to 170,000 vpd near North Avenue and increase 12 percent to 192,000 vpd just north of the Zoo Interchange. On US 45/I-894 south of the Zoo Interchange (near National Avenue), traffic is expected to increase 7 percent to 164,000 vpd in 2035. Future traffic volumes on I-94 are expected to increase 12 percent west of Highway 100, to 170,000 vpd, and remain at 174,000 vpd east of the Zoo Interchange (SEWRPC and WisDOT, 2008).

The increased traffic volumes will generally cause the north-south segment of the study-area freeway system to operate at a level of service F and the east-west segment to operate at a level of service E (**Exhibit 1-18** and **Exhibit 1-19**).

The areas noted on the previous page will continue to be congestion problems in the future. Many more locations on US 45/I-894 will operate at a lower level of service by 2035. Additional segments operating at level of service F in the design year include the following:

- Southbound US 45 between Burleigh Street (north study limit) and the Zoo Interchange during both the morning and evening peak hour
- Northbound US 45 between the Zoo Interchange and Burleigh Street (north study limit) during the morning peak hour
- Southbound US 45/I-894 between the Zoo Interchange and Greenfield Avenue during both the morning and evening peak hour

- Northbound US 45/I-894 between Lincoln Avenue (south study limit) and the Zoo Interchange during both the morning and evening peak hour
- Westbound I-94 between the Zoo Interchange and 124th Street (west study limit) during both the morning and evening peak hour
- Westbound I-94 between 70th Street (east study limit) and 84th Street during both the morning and evening peak hour
- Eastbound I-94 between the Zoo interchange and 84th Street during both the morning and evening peak hour

For the study-area freeway system to operate under acceptable conditions (level of service D or better), a combination of improvements need to occur to eliminate weaving, add freeway capacity, and extensively reduce freeway travel growth. The latter is unlikely given that traffic forecasts already assume a 100 percent increase in transit service throughout the region and a lower rate of traffic growth compared to the 1990–2005 growth rates.

### 1.3.6 Summary of the Need for the Project

The proposed action is needed to address the substandard characteristics of the study-area freeway system in order to maintain a key link in the local, regional, state, and national transportation network. The concrete box girder and voided slab bridges in the study-area freeway system are structurally deficient, and are difficult and expensive to rehabilitate due to their design. Other bridges in the study-area freeway system are substandard, deteriorating, and will require more frequent maintenance that will cause traveler inconvenience and delay.

The study-area freeway system's configuration is functionally deficient in many areas. Several areas have shoulders that are too narrow, and 22 bridges have a substandard vertical clearance. Additionally, the horizontal and vertical alignment is substandard in several locations, which results in poor driver sight distance.

The most notable functional deficiencies are the closely spaced service interchanges and the combination of left- and right-hand entrance and exit ramps, which are counter to driver expectancy and result in major safety problems such as weaving and congestion. All of the functional deficiencies combined create substandard conditions throughout the study-area freeway system, resulting in a higher-than-average crash rate in many locations. Several segments of the study-area freeway system have crash rates that are two to five times higher than the statewide average for urban freeways.

Current traffic volumes in the study area result in congestion and delays for Zoo Interchange travelers and shippers. Anticipated development and redevelopment in the study area, in particular the US 45 corridor north of the Zoo Interchange, will add additional traffic onto the already congested freeway. By 2035, the level of service is expected to be E or F, on a scale of A through F, for significant portions of the day on all four legs.

## 1.4 Local Government and Public Input

The public had the opportunity to review exhibits and see a presentation that illustrated the need for the project at open house workshops in January 2008. In general, those who spoke with the study team at the workshops or submitted written comments at or after the January 2008 workshops concurred with the need to reconstruct the study-area freeway system.

The Cities of Milwaukee, Wauwatosa, and West Allis agree the purpose and need for the project is sufficient, as do DNR, U.S. EPA, and the U.S. Army Corps of Engineers (Corps). Their comments are included in Appendix D.

## 1.5 Environmental and Socioeconomic Aspects

Environmental aspects are noted here because the factors documented in this section set the stage for development of alternatives, discussed in Section 2. The Zoo Interchange freeway corridor has a number of resources including streams, environmental corridors, wetlands, parks, neighborhoods, schools, and churches. When developing and evaluating the transportation improvement alternatives, WisDOT and FHWA consider preserving these resources, to the extent possible and practicable, an important factor in the development of alternatives.

For projects affecting resources protected under the Clean Water Act, the development of alternatives must consider the *Section 404(b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Material* administered by U.S. EPA and the Corps (1977). The guidelines state that dredged or fill material should not be discharged into aquatic ecosystems, including wetlands, unless no practicable alternatives can be demonstrated; such discharge will not have unacceptable adverse impacts; and all practical measures to minimize negative effects are undertaken.